Space Weather Technical Forecast

Issued on Tuesday, 09 April 2024 at 13:05 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: No significant activity.

Analysis of Space Weather Activity over past 24 hours.

Solar Activity: Solar activity has remained Low in the period, with the X-ray trace recorded by GOES16 and 18 languishing in mid-B-class for much of the past 24 hours in a trace reminiscent of solar minimum. An isolated C1.0 flare was observed at 09/0353UTC from the now faded AR3631 in the northwest quadrant.

There are now five remaining active regions on the Earth facing disc. There was slight areal growth seen in AR3633 in the southeast as a Dso/Beta, and slight proliferation of minor spots to the north of the main penumbral spot in AR3628, a Cho/Beta, with other regions stable and unremarkable.

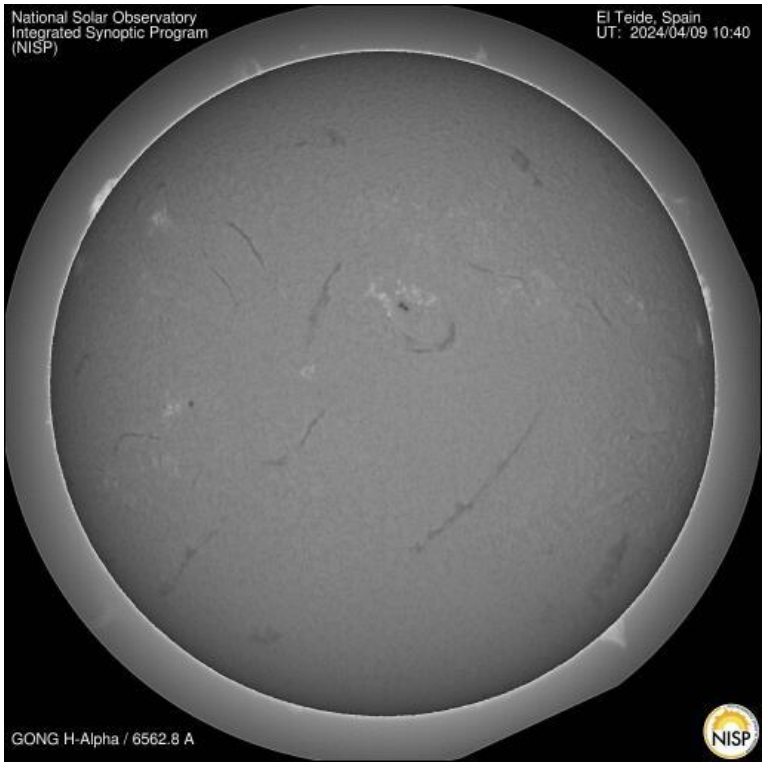

Figure 0: NSO GONG H-Alpha imagery from El Teide showing a relatively large population of filaments on the current disc. While there is nothing to suggest any lift-offs are imminent, this perhaps becomes more likely towards the UTC weekend with the return of the large and possibily destablising Ex-AR3615.

The current disc is heavily populated by filaments - perhaps rendered more durable by the lack of flares to de-stabilise them. Despite this, the only activity visible on coronagraphs was a

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probable far-sided northwest-directed Coronal Mass Ejection (CME), with no effect anticipated at Earth. No Earth-directed CMEs were in evidence.

Solar Wind / Geomagnetic Activity: The solar wind, as measured at L1 by DSCOVR showed a probable slow regime, with the solar wind speed generally ranging within the upper 300s of km/s. The solar wind density was at Background levels in single figures ppcc over the same period. The IMF was also mainly within Background, but with a slight rise seen as the period progressed to a Slightly Elevated 9nT in the current UTC morning. The north-south component correspondingly varied between +6 and -8nT, with an erratic tendency. The phi angle was mainly positive (away from the Sun).

The net result of the above solar wind measures was Quiet to Unsettled geomagnetic activity, provisionally recording Kp of 3+ in the 09-12UTC interval.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at Background levels.

High energy electron flux (greater than 2MeV) observed at GOES16 was at Normal Background levels. The associated 24-hour fluence remained well below the Active (1e8 integrated flux) threshold, on a declining trend, with a value of 1.93e6 integrated pfu recorded at 09/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Very Low activity is Expected at first, this potentially increasing into the coming UTC weekend as Ex-AR3615 starts to return over the eastern solar horizon.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the current forecast. Possible fast winds in the period are likely to be subdued, and although spells of Active intervals are possible, much of the coming four days should remain Quiet.

Energetic Particles / Solar Radiation: Solar radiation storms are considered a very low risk in the period given the lack of appropriate sunspot regions. High energy electron flux at GOES16 is expected to continue at Background levels. The associated 24 -hour electron fluence is expected to remain well below the Active (1e8 integrated pfu) threshold.

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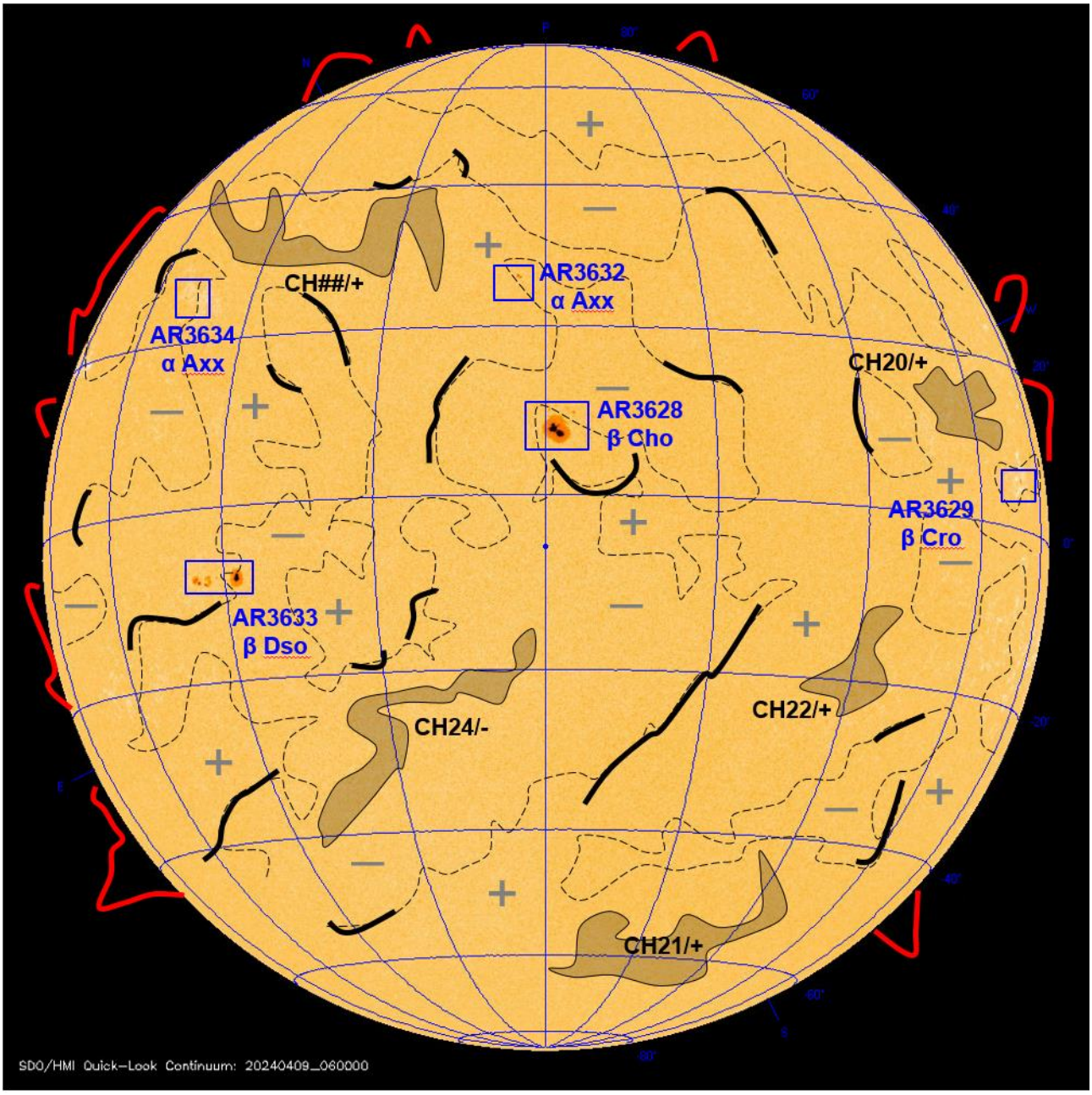
Figure 1. Solar Analysis Valid 09/0600UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

The geomagnetic forecast is of lower than average confidence, but also carries lower than average import, i.e. should produce relatively little activity despite this uncertainty.

Incoming fast wind streams are likely to be muted at first given the small size of the causative coronal holes and their (positive) polarity. No CMEs feature in the current forecast, however there are a higher number of ‘filaments’ than is typical on the Earth-facing side of the Sun – this is likely to seed an increasing risk of geomagnetic activity with time, as potentially de-stabilising X-ray flare activity picks up.

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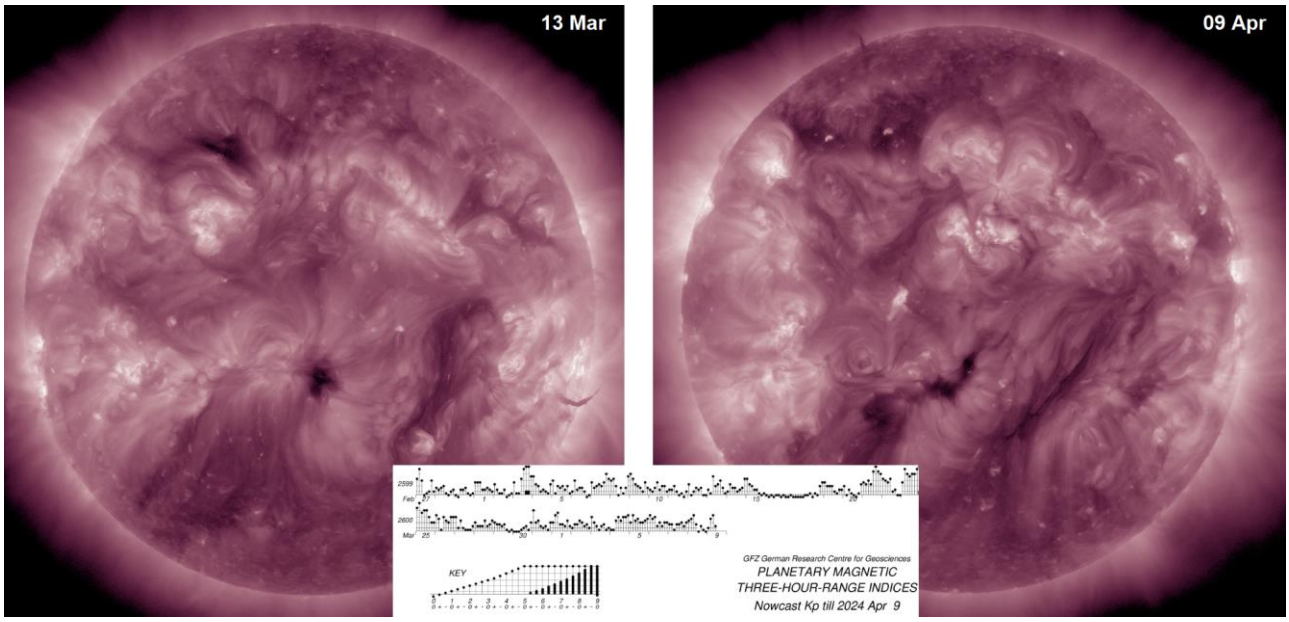
Another factor in the lower than average confidence in the geomagnetic forecast is MOSWOC Enlil, which is suggesting a strong high speed stream throughout this period with wind speeds peaking near 600km/s. Given current conditions in Enlil verify poorly with actuality, it is considered likely that Enlil is significantly overdone in its forecast. As such, wind speeds are expected to be at background levels, or perhaps slightly elevated should there be any weak high speed stream influence. Mainly Quiet to Unsettled geomagnetic activity is expected, perhaps with an isolated Active interval.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: SDO AIA211 imagery from previous and current rotations showing relatively tenuous coronal holes due in the period (compare with solar synoptic map, Figure 1) and resulting subdued geomagnetic activity from last pass.



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Radio Blackouts - X-Ray Flares:

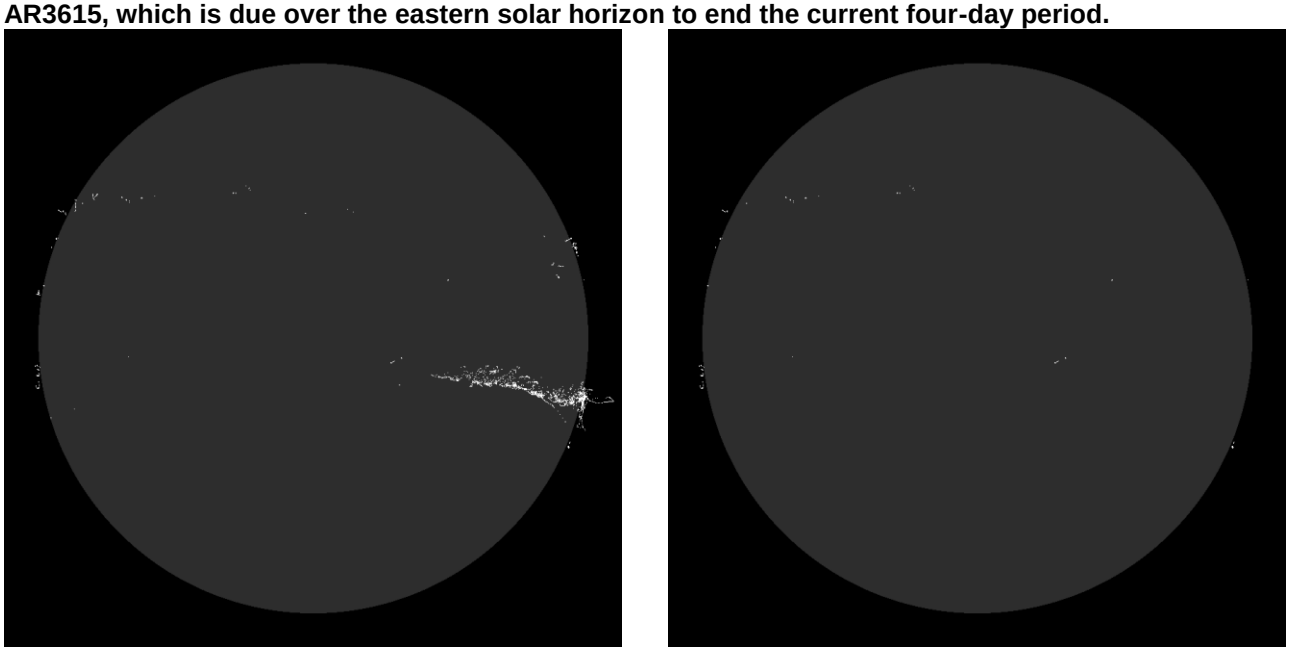
The facing side of the Sun is currently populated by relatively few, relatively simple sunspot regions, meaning the risk of significant X-ray flares is lower than it has been for some time – more akin to solar minimum at first. The chances of significant flares should, however, rise significantly from the coming UTC weekend given the expected arrival of at least one large and complex sunspot group from around the eastern solar horizon.

Far side seismographs suggest little in the way of significant regions to rotate on for another two to three days. However, later on Day four (Friday 12 April), we are likely to see the leading edge of Ex-AR3615 hove into view on the eastern solar horizon. This was a significant region on the last rotation and is likely to have survived its transit of the far side - with evidence until recently on Mars Perseverance imagery, ongoing evidence on far-side seismographs, and perhaps also CME evidence in recent days from this sector of the Sun.

The chances of significant flares should rise to nearer climatology over the four days, with the most notable uptick with the arrival of the leading portion of Ex-AR3615 into the coming UTC weekend.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	No	5	10	15	40
Very Active	**R3 to R5 X Class**	No	1	1	1	5

Figure 3: SIDC ROB processed X-ray flares at PROBA-2 of C-class and above for the past fortnight (left) and past week (right). Note the very significant contribution from the southwest quadrant group AR3615, which is due over the eastern solar horizon to end the current four-day period.



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux as observed by GOES18 is at Background levels. Solar radiation storms are considered a very low risk in the period given the lack of appropriately-flaring sunspot regions in better-connecting parts of the disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux is currently at Normal Background levels and likely to remain so through this period. Any high speed streams will most likely be weak, and therefore lacking the impetus necessary to increase electron populations at GEO significantly. Electron fluence is likewise forecast to remain well below the Active (1e8 integrated pfu) threshold throughout, with MOSWOC REFM giving good guidance in its stable trend around a decade below Active.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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